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Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

No. 188

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CONTENTS

WORLDWIDE AFFAIRS

Briefs

Syria, Laos Join Intersputnik 1

ASIA

INDIA

'APPLE' Successor Undergoing Test Series
(PATRIOT, 24 Sep 81).. 2

Briefs

Northeastern TV, Radio Expansion 3
Satellite 'APPLE' Temperature Snag 3

PAKISTAN

Priorities of National Space Program Outlined
(MORNING NEWS, 20 Oct 81).. 4

Telecommunications Development in Nation Reviewed
(Mian Munawwar-ud-Din; THE PAKISTAN TIMES, 13 Oct 81).......... 6

PEOPLE'S REPUBLIC OF CHINA

Briefs

Shanghai Satellite Station 10

EAST EUROPE

CZECHOSLOVAKIA

Briefs

Planned TV Transmitters Reported 11

LATIN AMERICA

BERMUDA

Cable, Wireless Plans Worldwide Decentralization in 1982 (THE ROYAL GAZETTE, 24 Sep 81).................................. 12

TRINIDAD AND TOBAGO

De Souza: Textel Has Program To Meet Future Requirements (TRINIDAD GUARDIAN, 22 Sep 81).................................. 13

Briefs

Telco Shortcomings 15

NEAR EAST AND NORTH AFRICA

EGYPT

Briefs

TV Station in al-'Arish 16

IRAN

Communications Network Being Restored in War Areas (Morteza Nabavi Interview; SOBH-E AZADEGAN, 26 Sep 81)......... 17

QATAR

Briefs

New TV Station 19

SAUDI ARABIA

Briefs

Contract for Telephone Net 20

SUB-SAHARAN AFRICA

INTER-AFRICAN AFFAIRS

Briefs
Satellite Communications System Integrated 21

GABON

Briefs
Satellite Link With Belgium 22

KENYA

Kenextel, KP&T Links, Roles Examined
(THE WEEKLY REVIEW, 25 Sep 81)................................ 23

Kenya's Sophisticated Two-Way Radio Market
(THE WEEKLY REVIEW, 25 Sep 81)................................ 25

Briefs
Satellite Station 27
Microwave Links 27
Repeater Booster Station 27
Seven Booster Stations 28

WEST EUROPE

ITALY

Fiber Optic Communications From Zinc Diffused GaAs LED
(Guido Chiaretti, ALTA FREQUENZA, Sep-Oct 81).................. 29

Linear Integrated Circuit Automatic Testing (LICAT) System
(Vitaliano Tassinari; ALTA FREQUENZA, Sep-Oct 81).............. 35

SWEDEN

Briefs
Fiber Optic Cables Introduced 41

BRIEFS

SYRIA, LAOS JOIN INTERSPUTNIK--Prague, 24 Oct (ANSA)--Syria and Laos are to join Intersputnik, the system of telecommunications satellites set up in 1971 by the ten countries of COMECON, the socialist countries' Common Market, it has been learned here. The two countries, the first to join the system from outside COMECON, filed their membership request at the tenth session of Intersputnik's council, which ended at Brno yesterday. According to informed sources, the council also decided to insert Vietnam's land stations for satellites into the system and examined plans to build new land-stations in Iraq, Afghanistan, Syria and Laos. Further decisions included modernization of land-stations already in operation, studies of how to improve exploitation of the orbits of geostationary satellites, and ways of extending the range of frequencies used. [Text] [AU241437 Rome ANSA in English 0821 GMT 24 Oct 81]

CSO: 5500/2026

'APPLE' SUCCESSOR UNDERGOING TEST SERIES

New Delhi PATRIOT in English 24 Sep 81 p 5

[Text] A SERIES of tests are being performed on the Indian National Satellite (INSAT-IA) successor to APPLE which is scheduled to be launched in early April next year.

The satellite, which would mark the first step towards taking the country's satellite communication technology virtually to the doorstep of the common man, is being built in the United States by the Ford Aerospace and Communications Corporation It would be launched by the Delta Launch Vehicle from Cap Canaveral.

INSAT project director P P Kale told UNI here today that the design review of the multipurpose telecommunications-cum weather satellite had been completed. The transfer orbit thermovacuum test had also been performed.

Mr Kale said after the thermovacuum test, the satellite had been integrated again and would now be taken through acoustic noise test, thermodynamic vibration test and final thermovacuum test. The satellite would be ready for launch after all these tests.

INSAT-IB

He said the integration work on INSAT-IB, to be launched in June 1983 by the Space Transportation System (STS), had also commenced.

Mr Kale said the master control facility at Hassan in Karnataka, which would provide telemetry and tracking support to INSAT, would be ready by the end of December or the middle of January.

Work at the Hassan complex was proceeding briskly. The complex had already received a major portion of spacecraft control system equipment. Installation work on equipment received from various agencies such as Space Application Centre and Electronics Corporation of India was being carried on now, he added.

The box-type INSAT would be a three-axis stabilised satellite like APPLE with a precision control system.

It would be positioned at its parking slot of 74 degrees east longitude about 36,000 km away from the surface of the earth.

INSAT would facilitate nationwide television and radio broadcasting, round-the-clock weather forecasting and long distance telephonic connections even with remote and inaccessible areas.

The satellite would have 12 transponders for telecommunications operating in C-band, two transponders for television and radio network and an instrument for earth observation for meteorological purposes.

The telecommunications component of the system would provide over 8,000 two-way long distance telephone circuits. The meteorological component would create facilities for round-the-clock weather forecasting and mapping the entire territory of the country.

The Posts and Telegraphs Department is setting up 31 stations, 28 fixed and three transportable, to utilise the INSAT communications capabilities.

CSO: 5500/7008

BRIEFS

NORTHEASTERN TV, RADIO EXPANSION--The entire northeastern region will be brought under TV coverage with the commissioning of Insat satellite early 1982. Disclosing this, the union information minister said the Imphal station of All India Radio will have a second channel soon. [BK260517 Delhi Domestic Service in English 1230 GMT 22 Oct 81 BK]

SATELLITE 'APPLE' TEMPERATURE SNAG--New Delhi, 23 Oct (AFP)--India's first experimental communication satellite "APPLE" orbited in July last, has developed a "temperature snag" after an eclipse early this month. Announcing this, the Indian Space Research Organization (ISRO) said in Bangalore today that the payload operations of the satellite had been thus suspended to enable the mission control at Sriharikota Islands, off the southeastern coast, to bring down the sensor temperature which had shown "abnormally high values not conducive to normal operations during midnight hours. APPLE (Ariane Passenger Payload Experiment) was orbited from French Guayana on July 19 by the European Space Agency. [Text] [Hong Kong AFP in English 1623 GMT 23 Oct 81 BK]

CSO: 5500/2026

PRIORITIES OF NATIONAL SPACE PROGRAM OUTLINED

Karachi MORNING NEWS in English 20 Oct 81 p 4

[Text] Mr Salim Mahmood, Chairman of Pakistan Space and Upper Atmosphere Research Commission, yesterday briefly outlined the priorities of the national space programme in the coming years.

Addressing students and staff of the NED University of Engineering Technology on "Pakistan activity in space," he discussed a four-phase long-term plan to develop Pakistan's capability in space research.

He said in the first phase, Pakistan had to develop the capability to intercept and receive TV signals and scientific data from orbitting satellites.

Secondly, a permanent ground receiving station had to be established to receive signals from orbitting satellites and negotiations with the US National Aeronautic and Space Agency currently in the final stage, to set up such a station at Islamabad at a cost of Rs 10 crore.

Thirdly, he said, Pakistan had to launch national satellite of its own which would provide telecommunication, telephone and TV channel serving the whole country and simultaneously take pictures for natural resources study and exploration, besides providing a computer TV and radio link up.

Fourthly, the long-term aim was to develop a satellite within the country and also to acquire capability to launch it into the orbit.

Educational TV

The SUPARCO Chairman said that a plan was also being drawn up to promote the use of educational TV in Pakistan with the aid of satellite.

Regarding the past achievements of SUPARCO in the field of space research, he said that so far the agency had launched 150 rockets into space since early 1960s.

He said these rockets reached an altitude ranging between 100 and 450 kilometers. Originally the SUPARCO had used imported rockets but now it was able to manufacture its own rockets which had a maximum range of 650 km altitude.

He said that SUPARCO had established Electronic Laboratory where it manufactured micro electronic and integrated circuits and other items of equipment needed in the development of electronic technology which was required for space research.

Mr Salim Mahmood briefly reviewed the progress in space research since the launching of first man-made satellite sputnik in 1957 by the Soviet Union.

In this connection, he mentioned the 1969 US moon landing by two astronauts and the establishment of record for the longest continuous stay in space (185 days) by two Russians. And lastly the launching of Voyager I and II spacecrafts by America.

Practical Uses

Mr Salim Mahmood said that satellite had a number of practical uses which included communication, transmitting TV programmes, taking pictures of the earth, acting as navigational bids, collecting scientific data etc.

He said that besides peaceful application of satellite technology it could serve military purposes also by taking pictures of military installations, army movements etc. and acting as control, command and communication base.

Thus, he said, modern warfare was shifting from the earth to outer space. He emphasised the need for Pakistan to enter the field as otherwise it would be at a disadvantage in modern scientific research and progress.

Mr Salim said that SUPARCO had acquired the ability to analyse and interpret satellite pictures and data.

He told the students that to carry out future programmes for development of space research and technology, 1,500 scientists and engineers and 1,000 Polytechnic graduates would be needed in the coming years.

He urged them to study hard and prepare themselves for the task so that country could enter the field of modern space research.

The SUPARCO Chairman invited NED University students to utilise library and research facilities of SUPARCO for study purpose and preparing their thesis.

The Chairman of NED University's Mechanical and Engineering Department, Prof. Dr Jamil Ahmed Khan thanked Mr Salim Mahmood for taking the time to address the students on this important topic.

Earlier, Mr Khalid Saeed, Chairman of NED University Scientific Society (which organised the function) presented the welcome address.

The function was presided over by the Vice-Chancellor of NED University, Dr A. T. Khan.

The President of the NED Students Union, Mr Rashid Ali Baig, also spoke briefly on the occasion. Later, an exhibition of a two-stage Shahpur Rocket, manufactured by SUPARCO, was held along with some satellite pictures and some other items.--APP.

CSO: 5500/4508

PAKISTAN

TELECOMMUNICATIONS DEVELOPMENT IN NATION REVIEWED

Lahore THE PAKISTAN TIMES in English 13 Oct 81, CTRL Inaugural Supplement, pp 1, 3, 4

[Article by Mian Munawwar-ud-Din, director general, Telephone and Telegraph Department]

[Text]

ROLE OF TELECOMMUNICATIONS IN THE ECONOMY: Pakistan like other developing countries of the world is confronted with many special problems in evolving an integrated economy. Some of these problems include the country's need to create a new Federal Capital and adequate lines of communication with each of the provinces; the shifting of Government agencies from Karachi to the new capital; the social and economic changes with the outflux of Pakistan immigrants and workers abroad, the distance separating the population centres and the wide dispersion of administration, industry and agriculture. These problems highlight the need for adequate telecommunication facilities which are vital to commerce, industry, agriculture and government administration. Expansion of our national industry involves the co-ordination of a series of operations which are highly dependent on adequate telecommunication facilities.

With the major parts of the population dependent on agriculture for their livelihood adequate telecommunication are necessary for sale of agriculture products, co-ordinate the timely delivery and transport of fertilisers. Promotion of tourism in the country is also largely dependent on telecommunications. With the country relying on imported petroleum supplies, the efficient and economical usage of the rather limited and costly transportation facilities is a vital necessity which can be achieved through reliable and adequate telecommunication services alone.

ROLE OF PAKISTAN T&T DEPARTMENT: All local, long distance and international public telecom services in the country are provided and operated by the Pakistan T&T Department. The T&T Department is also responsible for the licensing of commercial and amateur radio services and for the control of the radio frequency spectrum usage in the country including regulation and management of frequencies and operation of radio monitoring services. Like in other countries there are independent telecommunication networks (on smaller scale) operated by other services such as police, railways, civil aviation, oil, gas and power companies, etc., for their own use. However, these organisations have been provided leased telecommunication facilities by the T&T Department.

The T&T Department has established manufacturing facilities within the country certain telecommunication products in collaboration with manufacturers from abroad. The Telephone Industry of Pakistan (T.I.P.) established in 1952, manufactures telephone and telegraph switching equipment (manual and automatic exchanges of various capacities) telephone sets and teleprinters including typewriters. T.I.P. factories are located at Haripur and employs about 4,000 people. In addition another factory in Islamabad named C.T.I. established in 1969 manufactures semi-conductor components, carrier multiplex equipment and small capacity UHF radio systems. It employs about 400 people.

INLAND COMMUNICATIONS. As of June 1980 Pakistan has about 3,65,000 Exchange line capacity of which 41 per cent was automatic and the rest were manual exchange lines. There were about 3,58,000 telephones instruments and about 2,61,900 telephone lines for a population of 84 million people. This gives an average the telephone density of just over 4.3 telephones per 1,000 people which is very low by world standards and far too low to meet the information flow needs of the country's economy. Despite the deterrent of long waits that are usually measured in years, the waiting list for new telephone connections is about 2,00,000. In other words only 60 per cent of the total demand has been met so far.

This pending demand statistics are only maintained in communities that have already been provided with telephone service and thus understate real demand in the country as a whole. There is also a serious imbalance of telecommunication development between urban and rural areas. As of June 1981 there are 784 telephone exchanges in the country and 974 long distance public call offices (LDPCOs) serving the rural areas. Of the many thousands of communities in the country only about 1,758 places had an access to telephone service. Out of the 2,61,900 telephone subscribers about 54 per cent alone are concentrated in the three major cities of Karachi, Lahore, Islamabad/Rawalpindi with a further 24 per cent in the other larger towns and only 22 per cent in the thousands of other small towns and villages in the rural areas. There are at present about 7,000 long distance circuits out of which nearly 5,400 circuits are being used for Nation Wide Dialling (N.W.D.) and STD Services. NWD service is at present available for 50 cities and STD service to 15 centres. The long distance circuits are being provided both through the high capacity Coaxial Cable and Microwave links operating in the length and breadth of the country. Telex services are available to 17 major cities with about 2,439 subscribers. The wide band M/wave Links have the provision to carry TV Programmes within the country.

OVEREAS COMMUNICATIONS : Overseas telephone, telegraph and telex services are provided mainly through the satellite communications link with the world. For this purpose a Satellite Earth Station and the international switching and gateway centres have been set up in Karachi. The Satellite Earth Station which operates with the INTELSAT Communications Satellite in the Indian Ocean Region has at present the capacity for 252 satellite circuits of which over 243 are operational. Overseas TV Programmes can be received and transmitted through this Earth Station facilities.

Out of these 244 circuits 17 circuits are dedicated for telegraph and telex working directly with 16 countries (more countries are available on transit). The remaining 227 circuits are providing automatic, semi-automatic and manual telephone circuits directly to 24 countries and over 156 countries on transit basis.

The automatic service (International Subscriber Dialling—ISD) is available for the moment with 14 different countries namely Saudi Arabia, Kuwait, UAE, France, Italy, West Germany, Switzerland, Iran, Ireland, Japan, Oman, Behrain, Singapore and U.K. This facility is likely to be extended to other major countries as well. The semi-automatic service (Operator Trunk Dialling OTD) is available to all other countries except for China, India, Bangladesh, Turkey which operate on manual telephone circuits (Operator to Operator working).

The automatic and semi-automatic telephone service is being controlled and operated through the International Gateway Exchange at Karachi which started operation in July 1980. This gateway exchange has presently the capacity to handle 300 international telephone circuits. This capacity can be expanded up to 900 circuits. This gateway exchange handles the overseas traffic to and from all the NWD centres in the country (50 cities). The ISD service can be provided to about 25,000 subscribers initially and is at present limited to cities namely Islamabad/Rawalpindi, Karachi, Lahore, Faisalabad, Quetta, Peshawar only. At the moment this exchange is handling about 2.5 million paid minutes per month (August 1981 figure) of overseas telephone traffic or about 12,000 calls daily. H.P. Radio links for telephone and telegraph traffic is working with Moscow, Thailand (Bangkok), Nepal (Khatmandu) and Nairobi. Overhead Carrier lines are operating with India alone at present.

The overall growth of Telecommunication for the period 1976 to 1981 can be seen at a glance from the table given below :

PRINCIPAL TELECOMMUNICATION STATISTICS (POSITION JUNE 80)

	1976	1977	1978	1979	1980	1981
1. No. of Telephone (in Thousands)						
i) Auto Line	169.00	178.00	190.00	214.94	232.94	259.23
ii) Manual	18.50	19.00	19.83	20.43	20.96	22.66
TOTAL :	187.50	197.00	209.83	235.37	253.27	281.89
2. No. of telephone Instruments (in thousand)	249.00	274.00	288.00	314.00	330.00	358.00
3. No. of Exchange Line (in thousands)						
i) Auto	225.70	242.30	259.50	286.40	303.30	330.84
ii) Manual	31.30	32.30	31.46	30.98	31.77	34.15
TOTAL :	257.00	274.60	290.96	317.38	335.07	364.90
4. No. of Exchanges						
i) Auto	111	125	138	190	195	202
ii) Manual	518	527	529	530	549	582
TOTAL :	629	652	667	720	744	784
5. Pending Telephone Demand in thousands) Auto + Manual)	120	130	150	173	200	200
6. Long Distance Public Call Offices	553	745	750	873	920	974
7. All places with telephone facilities (4 + 6)	1182	1397	1417	1593	1664	1758
8. No. of Telex Exchanges	6	7	9	9	9	11
9. Telex Exchanges Lines	1330	1360	2800	2800	2810	3530
10. Telex working connections	678	853	1044	1728	2355	2439
11. Telex pending demand	350	637	996	1229	1701	2480
12. No. of STD stations.	15	15	15	15	15	15
13. No. of STD Channels.	1460	1460	1460	1460	1460	1460
14. STD Calls (in millions)	55.10	55.00	50.05	41.67	35.19	32.22
15. No. of NWD stations	5	13	36	45	49	49
16. No. of NWD Channels	108	769	2339	3720	3899	3899
17. NWD Calls (in millions)	—	—	17.75	39.72	58.77	77.09
18. Trunk Positions	537	575	593	604	610	630
19. Manual Trunk Traffic (in millions)	16.66	19.36	25.85	18.48	18.57	17.33

DEMAND FOR SERVICE: As mentioned earlier there exists a pending demand for over 2,00,000 telepphone lines. This demand has increased historically by about 12 per cent per annum over the past ten years. With increased economic activity and extension of service to new areas the demand is expected to be about 50,000 lines annually.

Statistics indicate that the automatic trunk traffic (STD/NWD) over the long distance routes has been growing at the rate of about 19 per cent per annum. With the development of STD/NWD service in the country the manual traffic has not increased much. Its growth has been just 2.3 per cent over the past five years. The long-distance circuit requirement increases with the increase in the telephone subscribers in the country. Heavy usage of the long distance lines is evident because of the over flow of millions of calls which cannot be put through because of shortage of the long distance outlets on various sections of the national back bone network.

At present there are eleven telex exchanges in the major cities of Islamabad/Rawalpindi, Lahore, Karachi, Hyderabad, Quetta, Sukkur, Peshawar, Multan, Faisalabad, Gujranwala, and Sialkot having a total capacity of about 3,500 lines and 2,439 operational subscribers. There is a pending demand of about 2,500 connections. The demand has been growing at the rate of 36 per cent per annum over the past five years.

The demand for international communication for telephone and telex has been growing rapidly since 1972 with the introduction of satellite communication in the country. The growth can be well estimated by the fact that in 1972 the number of satellite circuits were only 13 and at present over 240. The telephone traffic has been growing at the rate 24 per cent and the telex traffic increased over 40 per cent per annum. With the cut over of the international gateway exchange and the introduction of automatic and semi-automatic service this traffic has increased manifold.

FUTURE PLANNING

The T&T Department from the very beginning has been operating under great pressure over which it has no control, planning remained subject to financial constraints. The T&T Department is faced with the challenges of rapid growing demand, clearing of the backlog and the rapid changes in the technology development besides maintaining and operating the existing facilities efficiently. The under-provision of the subscriber connections and in-adequate expansion of the network has resulted in very heavy use of the available telephone, rapid increase of subscriber busy conditions and repeat call attempts, together with over loading of the exchange equipment. All such factors contribute heavily to the poor service in the major city networks. The T&T Department has been well aware of these factors and has been planning both on short and long term, various schemes to improve the situation. But due to the limited foreign exchange funds availability, financial constraints and priorities imposed by the Government the T&T Department had to curtail the size of its development schemes and as such it seems that for a few years ahead no remarkable change in the existing situation would take place. The Department is however pushing ahead with the various development schemes in order of priorities. This would certainly help in easing the existing situation. During the remaining period of the Fifth Plan (termed as mid-term plan 1981-83) the T&T is envisaging to realise the following objectives :

a) Augment the long distance and subsidiary trunk routes capacity to cope with 14 per cent annual growth in traffic and to connect new places and remote areas in NWFP and Baluchistan including Mekran Coast through new Microwave links. This would increase the existing long distance channel from 7,000 to over 12,000 channels.

b) Expansion of the existing telephone exchange and network capacity by 52,000 lines (against the estimated demand of over 300,000 lines by 1983

c) Accelerate and expand telephone facilities to the rural areas of all the four provinces by establishing 300 long distance PCO's.

d) Expansion of the telex facilities for some 3,200 additional subscribers and extension of telex and telegraph networks accordingly.

e) Addition of 11 NWD centres. The following towns are planned to be included Attock, Burewala, Charsadda, Chichawatni, Chishtian, Daska, Hafizabad, Kamoke, Pakpattan, Pipri, Shikarpur.

f) Replacement of 9,000 telephone lines of old F-1 Exchanges.

g) Expansion of the existing Overseas Communication links by expanding the existing Satellite Earth Station (at Dehmandro) Capacity from 252 channels to 384 channels. Expansion of the International Gateway Exchange capacity is also planned accordingly.

h) Setting up of a second Satellite Earth Station and a Gateway Exchange at Islamabad to cater for the future overseas traffic requirement beyond 1983-84 and diversifying the overseas outlet centres.

i) Upgradation of the microwave link between Pakistan and Iran.

j) Transborder linkage on coaxial cable between Lahore Amritsar for India-Pakistan telecommunication traffic as a part of the Asian Telecommunication Network

CSO: 5500/4507

BRIEFS

SHANGHAI SATELLITE STATION--Shanghai, 27 Oct (XINHUA)--The Shanghai satellite communications ground station ranks first in communications quality among the world's 212 international satellite communications ground stations. This is according to statistics compiled by the International Communications Satellite Organization. The Shanghai Administration of Posts and Telecommunications has been notified of this. As a rule, the International Communications Satellite Organization compiles statistics semiannually on the communications quality of ground stations in various countries of the world. The main business of the Shanghai satellite communications ground station is international telephone, telegram, television and facsimile transmissions. According to regulation standards, the rate of circuit clearness at a station's end should reach 99.98 percent. In the first half of this year the Shanghai satellite communications ground station's antenna, receiving, transmitting, power supply and other equipment all had a serviceable rate of 100 percent, and its circuit clearness rate ranked first among the world's 212 stations. [Text] [OW280145 Beijing XINHUA Domestic Service in Chinese 1450 GMT 27 Oct 81]

CSO: 5500/2026

CZECHOSLOVAKIA

BRIEFS

PLANNED TV TRANSMITTERS REPORTED--The construction of the broadcasting and transmission system for the second television channel is among the communication sector's important tasks. In 1970 it had 4 transmitters at its disposal. At present there are 36 of them and in the course of the current 5-year plan [by 1985] the following additional transmitters will be completed--Prague-City, Rychnov and Kneznou, Stara Lubovna, Banska Stiavnica, Trencin and Roznava. ["Ei"-signed report in the column "Briefly"] [Text] [AU151448 Prague MLADA FRONTA in Czech 14 Oct 81 p 2]

CSO: 5500/3002

CABLE, WIRELESS PLANS WORLDWIDE DECENTRALIZATION IN 1982

Hamilton THE ROYAL GAZETTE in English 24 Sep 81 p 15

[Text] **BERMUDA's communications services are to come under careful financial scrutiny next year as part of a Cable and Wireless plan to decentralise its worldwide operations.**

The plan, unveiled last week in the British state-owned group's annual report, calls for reorganisation of the London headquarters and the sharing-out of "profit responsibility. . . to each operating unit".

Up to 40 percent of the group's 2,000 London-based staff are expected to lose their jobs over the next three to four years in a programme of planned redundancies.

The company is clearly anxious not only to position itself for future expansion but also to show potential investors that its shares will be worth having when they are offered to the public this autumn.

The reorganisation means that the Bermuda branch will become fully accountable for its activities probably from next April. Although this raises the spectre of a more profit-orientated operation here and possible cutbacks or price increases in services found not to be pulling their financial weight, local general manager, Mr. Harry Saunter, feels that such a prospect is unrealistic.

He told Business Week: "We have not yet been given a clear indication of what all this will mean for the local operation, but the possibility of any change in the services we presently provide is highly unlikely."

Though Mr. Saunter concedes that the Bermuda branch will almost certainly come under increased pressure to produce group revenue, he predicts that the most significant developments for the local office will stem from a greater degree of autonomy. He thinks that this could include purchasing responsibilities and the production of accounts — both of which are functions presently carried out in London.

- Cable and Wireless group pre-tax profits for the year to March 31 increased to £62 million (£61m) while turnover grew to £293 million (£254.8m). The British group does almost all its business overseas with operations in Hong Kong and Bahrain, together accounting for its largest source of revenue.

CSO: 5500/7504

DE SOUZA: TEXTEL HAS PROGRAM TO MEET FUTURE REQUIREMENTS

Port-of-Spain TRINIDAD GUARDIAN in English 22 Sep 81 p 1

[Excerpts] A government minister has blamed the country's rapid development for the lack an "ideal development plan." Public Utilities Minister Mervyn De Souza, said such a proposition was extremely difficult, if not impossible.

Opening the eight-day Ninth Specialist Group Network Operations meeting of the Commonwealth Telecommunications Council at the Trinidad Hilton yesterday, Senator De Souza noted that Trinidad and Tobago was endeavouring to expand its industrial and commercial potential while simultaneously providing social amenities for the citizens.

On a more positive note, Minister De Souza mentioned that the Trinidad and Tobago External Telecommunications Company Limited (Textel) had a programme of expansion geared to meet the present and projected demand during the 1980s.

This consists of:

--In collaboration with the Trinidad and Tobago Telephone Company (Telco), Textel is expanding its classified telephone service including international subscriber dialling;

--Introduction of microwave links from Port-of-Spain to Tobago and to Piarco airport.

--A new tropospheric road link to be installed between Trinidad and Guyana in order to improve the efficiency in the telecommunication between both countries;

--A computerised telephone message switch is planned for installation thereby eliminating manual operation of our telecommunication system and introducing an automatic system;

--Feasibility and other studies are under way with regard to possible installation of a digital telephone exchange and digital backhaul links in the latter half of the 1980s, and;

--Preliminary planning is being done for the installation of facilities to provide data services to the public.

Minister De Souza, in highlighting the demand on the telephone services, disclosed that in 1970, overseas calls from Trinidad and Tobago totalled 173,201, and for the first eight months in 1981, the figure was 355,645.

Delegates at the session, which ends September 29, come from 17 countries including Barbados, Australia, Britain, Canada, Hong Kong, Jamaica, Kenya, New Zealand, Papua New Guinea, Singapore, Uganda, Guyana, Nigeria and host country Trinidad and Tobago.

They will tackle a number of issues including network development, network management, forecasting, route dimensioning, grade of service, maintenance, trouble shooting, restoration and the network implications of new services.

CSO: 5500/7504

TRINIDAD AND TOBAGO

BRIEFS

TELCO SHORTCOMINGS--Trinidad and Tobago Telephone Company (Telco) continues to provide a service below what could be described as acceptable despite the massive injection of funds into the State-owned utility. This strong observation has been made by the Public Utilities Commission in its current news review. It was stated that the balance sheet of Telco showed that its authorised share capital was increased during the year with the issued and fully paid up share capital increasing from $58.1 million in 1979 to $121.1 million in 1980. One new long term loan from the Export/Import Bank of Japan was contracted during the year. The review continued: "The Government of Trinidad and Tobago continued to inject large amounts of funds into the company. Of the amount advanced by the Government in 1980, $24.5 million was advanced from the development fund over the period 1976-1979. "The interest rate on this loan is 8.5 percent per annum. The loan from the Japanese bank was used for the financing of the purchase and installation of 48,000 lines of Japanese central office switching equipment. In spite of this massive injection of funds into the telephone company, service continues to be below what could be deemed acceptable." [Excerpts] [Port-of-Spain TRINIDAD GUARDIAN in English 5 Oct 81 p 3]

CSO: 5500/7505

BRIEFS

TV STATION IN AL-'ARISH--Egypt is planning to establish a high power television station in al-'Arish, whose broadcasts will be received in all the Arab countries. The Egyptian authorities have sent a delegation of experts to al-'Arish to examine the possibility of establishing the television station in the town. At present Egyptian television broadcasts over two channels whose frequencies are almost identical to the two channels used by Jordanian television. As a result of this the television broadcasts from Jordan are being disrupted. The Egyptian television broadcasts' power will be stronger than those of Jordan. [By Eli Danon] [Text] [TA230942 Tel Aviv MA'ARIV in Hebrew 23 Oct 81 p 12]

CSO: 5500/5001

COMMUNICATIONS NETWORK BEING RESTORED IN WAR AREAS

Tehran SOBH-E AZADEGAN in Persian 26 Sep 81 p 4

[Interview with Engr Morteza Nabavi, Minister of Post, Telegraph, and Telephone]

[Text] The Minister of Post, Telegraph, and Telephone spoke of this ministry's plans for establishing communications between various parts of the country on the occasion of War Week.

Engineer Morteza Nabavi, Minister of Post, Telegraph, and Telephone, began by discussing this ministry's role in establishing post and telegraph communications in the country's war zones. He said: "The Ministry of Post, Telegraph and Telephone has been able, with the help of all the military organs such as the army, the revolutionary guards, and the other military and police forces, to establish communications. In this connection our fellow workers have put forth all their efforts in order to be able to bring about the best kind of communications using the limited resources available, especially in the war zones. The front line of our technical fellow workers, all of whom are from the deprived class of our nation, have put forth all their efforts and have eagerly rushed to the battlefields. Among other measures taken by the ministry has been the establishment of telephone centers at bases and other military areas in order to set up communications between our brother soldiers and their families." Engineer Nabavi added, "Throughout the past year while we have been at war our brothers have rushed to the war stricken areas at the appropriate times and repaired the destruction the enemy has wreaked upon us. Among the cities where damages to the telegraph systems have been repaired in a timely manner and communications restored are Dezful, Ahvaz, Abadan, Koredestan, Ilam, and Kermanshahan."

"Committed forces have helped very much in this process, especially the brothers in the Islamic Council, who were active in this work and even presented martyrs to the Islamic revolution." Concerning other help given to the war zones by this ministry, he said: "In provinces where the Ministry of Post, Telegraph and Telephone has houses, these houses were made available to families hit by the war. Funds were also set aside so families could get the necessary loans, particularly in the form of interest-free loans with an unstipulated due date. Of course, in connection with War Week our fellow workers in various Post and Telegraph departments collected cash and material assistance, and some of them even gave part of their salaries to war stricken brothers during War Week."

He added, "There are plans this week for officials to go to the war zones and try to eliminate some of the malfunctions there."

Concerning workers in the war zones who have lost their jobs, the Minister of Post, Telegraph, and Telephones said "Most of our brothers are in the war zones, but efforts have been made to make use of those who cannot be in those areas in other provinces." Concerning the repair of destruction and of the central areas that have been destroyed by war, he then said,

"A staff is being formed now to deal with this and to develop a program so that there will not be a problem in the future, because as soon as the war is over and the people go back to their cities they will need telephones and postal services. Fortunately War Week gave us the idea to get started on this. In the matter of postal service the attempt has been made to provide free postal service for the brothers in the war so that their letters will reach their destinations free of charge. With respect to this if our brothers will make use of the directives printed by the Ministry of Guidance there will be no need for restoration."

"The bases and other military areas have also agreed to collect their letters and packages at the proper times and to sort and distribute them on a priority basis and to deliver them to them."

In conclusion the Minister of Post, Telegraph and Telephone said: "We believe we must fight the polytheists, infidels, and hypocrites until they give up on the useless idea that they can create new trouble for us. All the people are now caught up in war, internally with domestic hypocrites and on the fronts with Saddam's infidel forces. It is with the Imam's inspirational messages, and the heavenly messages of the Koran, which is the way of salvation for man, that we can hold out hope that, just as God promises, and all God's promises are true, we can be an exemplary nation for all the deprived and oppressed nations of the world. With the hope of the final struggle, and the hoisting of the banner of Islam throughout the world.

9310
CSO: 5500/5305

BRIEFS

NEW TV STATION--It has been announced in Doha that Qatari television will begin to transmit on a new channel beginning 1 November. The new channel will transmit from 2000 to 2300 daily. It will carry Arab and foreign films and series in addition to live relays of world cup soccer matches. [GF291308 Manama Gulf News Agency in Arabic 0530 GMT 29 Oct 81 GF]

CSO: 5500/2026

SAUDI ARABIA

BRIEFS

CONTRACT FOR TELEPHONE NET--The Philips group of Holland and LM Ericsson have received a large new order totaling 1 billion kronor (500 million guilders) from Saudi Arabia for further modernization of the Arabian kingdom's telephone network, it was announced Wednesday at Philips headquarters. Including the new order, Saudi Arabia has placed orders with this Swedish-Dutch joint venture for a total of almost 24 billion kronor (111 billion guilders) during the past 4 years, Philips added according to AP. According to the new contract, Philips and LM Ericsson will install 27,000 and 14,000 customer phone lines, respectively, and a number of central exchanges. In addition, the Saudi government has decided to expand the cable network additionally for extra capacity for further growth in the future. Philips will supply most of the cables. The telephone network the two companies are installing in Saudi Arabia presently consist of just over 1 million lines, of which Philips is responsible for about 650,000, executives of the Dutch company added. [Text] [Stockholm DAGENS NYHETER in Swedish 1 Oct 81 pp 1, 12] 9336

CSO: 5500/2015

BRIEFS

SATELLITE COMMUNICATIONS SYSTEM INTEGRATED--Maputo, 26 Oct (TASS)--Africa is planning to establish an integrated satellite communication system by [date indistinct], which will make it possible for young African states to do away with dependence on former colonial powers in the field of telecommunications. Its project within the Pan-African Documentation and Information System [PADIS] was endorsed at a conference of communication experts from African countries which has ended in Mozambique's capital. The participants in the conference supported a plan to set up national centres for collacting, processing and using information and documentation for the purpose of promoting economic progress. The conference stressed the importance of organising broad exchange of information between African countries within PADIS. Speaking at a press conference after the conference Mr. Kirino-Lanhummei, director of PADIS, stressed the importance of establishing an integrated information system in Africa. He said that the conference regarded measures taken by African countries to reach independence in the sphere of information as a component part of the process of decolonisation. [Text] [LD271120 Moscow TASS in English 0920 GMT 26 Oct 81]

CSO: 5500/2026

BRIEFS

SATELLITE LINK WITH BELGIUM--The president of the republic, His Excellency El Hadj Omar Bongo, continues his European tour. Yesterday, the head of state and the delegation accompanying his arrived in Brussels in the second stage of this tour. They were welcomed by King Baudouin and Queen Fabiola. This afternoon, President Omar Bongo was scheduled to inaugurate the Libreville-Brussels satellite telephone line. The inauguration of the line was first announced, as you know by Robert Urbain, minister of foreign trade, at the end of an official visit to Gabon last September. Moreover, two agreements were also signed this afternoon. The first agreement was on foreign trade and the second was on merchant marine. [Excerpt] [AB301132 Libreville Domestic Service in French 1830 GMT 29 Oct 81]

CSO: 5500/5614

KENEXTEL, KP&T LINKS, ROLES EXAMINED

Nairobi THE WEEKLY REVIEW in English 25 Sep 81 p 36

[Text]

AMONG developing countries, Kenya seems to possess a much greater awareness of the importance of telecommunications. In the current five year (1978/83) development plan period, Kenya expects to spend a total of £51.5 million on telecommunications mainly through the Kenya Posts and Telecommunications Corporation and the Kenya External Telecommunications Company (Kenextel). The KP&T deals with internal services, whilst Kenextel deals mainly with external telecommunications matters, controlling among others international telephone, telex and telegrams.

What is today Kenextel came into being in 1964 when the governments of Kenya, Uganda and Tanzania decided to take over control of communications with the outside world which until then had been run and controlled by a British firm, Cable and Wireless. The three governments then jointly bought controlling shares in the firm, a move that culminated in the formation of the East African External Telecommunications company (Extelcoms) as one of the organs of the East African community. Extelcoms lasted until 1977 when the East African Community broke up. The affairs of the community within Kenya were taken over by the newly formed Kenextel.

The 14 years during which Extelcoms existed saw external telecommunication facilities expand and improve immensely. By 1968 it was clear that the only way telecommunications could be effectively expanded was through a satelite earth station. Hence the construction in 1970 of the Mt. Longonot satelite earth station. The main medium of telecommunications in Kenya before the satellite was built was high frequency (HF) radio. The total traffic carried over the system at that time was 300,488 telephone minutes, 277,531 telex minutes and 456 telegraph messages per year. When the Longonot satellite earth station became operational, the traffic in respect of telephone telex and telegraph went up in the first year. The rates of increases were 60 per cent for telephone, 22 per cent for telex and 5 per cent telegrammes. A second antenna of the Longonot station was officially commissioned in March this year. Previously the satellite station had links with about 15 countries. With the antenna in operation, the number of countries having direct links with Kenya doubled. Apart from providing direct links with the outside world, the antenna, which faces the Atlantic Ocean satellite, will save the country more than shs 5 million by cutting down on a number of transit points.

For international services Kenextel works closely with the KP&T. All subscribers for telephone services are connected on the national network. Thus, during the early stages of an international telephone call, a subscriber uses the national network to get access to the international switchboard, which is also operated by the Kenya Posts and Telecommunications. The international exchange operator then obtains the desired connection by using links connecting the switchboard to the international gateway exchange operated by Kenextel. Kenextel's gateway exchange is connected to several countries in the world thus affording direct access by the operator to these countries. International subscriber dialing (ISD) has been introduced and in some cases it eliminates the need to go through an operator in order to place an international call.

The massive expenditure Kenya will be making on telecommunications over the next five years means that by the end of the plan period, Kenya will possess one of the most sophisticated telecommunications systems in Africa. In the next decade or so even more revolutionary services may be introduced. Currently under consideration is the idea of video conferencing, whereby studios in major cities of the world will be interlinked to provide instant video conference facilities. It is envisaged that several studios will be hooked up in as many cities in any part of the globe to bring about a conference of people many miles apart. Also in the pipeline, and closer to reality, is electronic mail. This is a process which enables a customer wishing to deliver his letter to a foreign country to key the code to the required city and within seconds a copy of the letter is reproduced at the destination and delivered by express mail to the addressee. Thus, a letter which normally takes five to ten days to get overseas by the fastest means available today, may take only five minutes by electronic mail. That is the picture of things to come. ■

CSO: 5500/5615

KENYA'S SOPHISTICATED TWO-WAY RADIO MARKET

Nairobi THE WEEKLY REVIEW in English 25 Sep 81 p 38

[Text]

THE two-way radio communications market in Kenya is probably the most sophisticated in black Africa today. Various government bodies have had radio communications networks operating for the last forty years or so, and until recently most dealers in the telecommunications equipment have dealt primarily with the government.

This is not to say that private networks are not allowed. Far from it. There are of course strictly defined guidelines within which private organisations may use two-way radio, but the last year has seen a market increase in the private market, bearing witness to the fact that vastly increased efficiency results from being able to "keep in touch". Major private users include transportation companies, and security and construction companies, and the local public transport service, but even small retailers and service companies are seeing the advantages of using radio communications equipment to maximise staff and vehicle efficiency. A conservative estimate gives savings as being up to 25% in transportation costs, these being more simply calculated than manpower savings.

The Kenya Posts and Telecommunications Corporation (KP and TC), as the controlling body for all telecommunications usages in Kenya, has shown tremendous foresight in its planning of radio communications for the country. Rarely does a business with a real need for radio communications have an application turned down by the KP&TC private radio network committee.

In fact, in keeping with Kenya's current development programme, emphasis has been placed on fuel conservation through the use of two-way radio, and the KP&TC are making available to the public some of the very latest innovations in communications technology as a result.

There is an efficient paging service being offered, where constant contact can be made with people on the move. This is provided by the KP&TC on similar lines,as the telephone service, but smaller, private paging networks are permitted. These have proved invaluable, in use in hotels, and bi-industrial complexes, where key staff are often on duty of their offices, not to mention the advantages to doctors and medical staff on call in various locations.

A community repeater service has recently been installed, specifically for small users of two-way radio who need good coverage but do not want to invest in costly and sophisticated base station equipment. This repeater operation greatly enhances the working of mobile and portable radios, and the easy availability of allocations for repeater use make this a most popular facility in and around Nairobi.

It is worth mention here, that the radio-call system has long been available in Kenya, providing essential contact for farms and lodges and hospitals in out-of-the-way areas. This is also provided by the KP&TC, giving communications between telephone and radio users nationwide, twenty-four hours a day.

The most important aspect of radio communications administration in any country is frequency management. This is efficiently taken care of here by the KP&TC, and all users of any type of radio communications equipment must comply fully with the regulations and licensing stipulations. This is essential if existing users are to have clear communications, and the importance can be seen when considering the use of radio by air transport controllers, police, and medical workers.

The most important aspect of the supply of radio communications equipment is clearly the technical advice required. ■

CSO: 5500/5615

BRIEFS

SATELLITE STATION--The feasibility study on the establishment of the proposed Regional Earth Resources and Satellite Ground Receiving and Processing Station in Nairobi has been completed. The station is estimated to cost more than Shs. 163 million. The seven-month study, which cost approximately Shs. 500,000, was presented to the Minister for Environment and Natural Resources, Mr A.J. Omanga, yesterday by the French Ambassador to Kenya, Mr Roger Duzer. The feasibility study for the centre, which is expected to serve 18 countries in Eastern and Central Africa, was jointly conducted by the Ministry and the French National Centre for Space Studies (C.N.E.S.). Mr Omanga thanked the French Government for meeting most of the incidental costs of the study and said the Kenya Government had also contributed. The Minister said the completion of the study was just a beginning, adding the report would be distributed to other member states in the region for review and advice. He said implementation of the project depended on their goodwill and support. The Ambassador said C.N.E.S. had accumulated remarkable experience and technology in space research and industries. He said the project would help African countries to work together. [Text] [Nairobi THE STANDARD in English 16 Oct 81 p 5]

MICROWAVE LINKS--A microwave link that will improve telex, telephone and telegraphic services between Ethiopia and Kenya went into operation yesterday. The link is part of plans by Pan-African Telecommunications (PANAFTEL) to develop communications between Djibouti, Ethiopia, Kenya, Uganda, Tanzania and Zambia. It is expected to extend north into Sudan within five years. [Text] [Nairobi THE STANDARD in English 29 Sep 81 p 3]

REPEATER BOOSTER STATION--The Ministry of Information and Broadcasting plans to build a repeater booster station at Lodwar to improve radio and television reception in northern Kenya, the Minister for Information and Broadcasting, Mr Peter Oloo Aringo told a meeting at Lokichar, Lodwar and Kalokol during a tour of Turkana District recently. Mr Aringo said the mass media played a major role in unifying the nation and as such, his Ministry was committed to improving the communication systems all over the country. Mr Aringo, who was accompanied by his Assistant Minister, Mr Nteere Mbogori, the Director of Information, Mr Laban Kabiro, the chief engineer V.o.K., Mr Simon Macharia and other senior officials in the Ministry, said the Ministry intended to attain a 100 percent radio audience. Currently the V.o.K. network reaches more than eight million listeners. The Minister added that the content and relevance of radio and TV programmes would be improved. [Text] [Nairobi THE STANDARD in English 17 Oct 81 p 5]

SEVEN BOOSTER STATIONS--The Government will spend more than Shs. 200 million to provide seven transmission stations in various parts of the country so as to boost radio reception and motivate faster rural development. This was disclosed yesterday by the Minister for Information and Broadcasting, Mr Peter Oloo Aringo, when he laid the foundation stone of the Nyamninia medium-wave transmitting station being constructed near Yala township in Siaya District at a cost of Shs. 25.4 million. The minister said it was the Government's policy to utilise the mass media to educate the masses on how to improve their own general welfare and also to cement good relations with neighbouring countries. The Minister, who was accompanied by his two assistant Ministers, Mr Alphonse Okuku and Mr Nteere Mbogori, as well as the Director of Information, Mr Laban Kabiro, said the transmission station at Yala which is the largest in Western Kenya, would reach more than six million people in the region between Pokot and Kajiado Districts, apart from flowing over into Uganda, Ethiopia, Sudan, Somalia and Tanzania. The boosted radio reception, he said, would be used purely to promote mutual understanding between Kenya and her neighbours--unlike that of other government-controlled stations, which promoted propaganda so as to create confusion. [Text] [Nairobi THE STANDARD in English 3 Oct 81 p 2]

CSO: 5500/5615

FIBER OPTIC COMMUNICATIONS FROM ZINC DIFFUSED GAAS LED

Liman ALTA FREQUENZA in English Sep-Oct 81 pp 242-247

[Article by Guido Chiaretti, CSELT, VIA G. REISS ROMOLI 274, 10138 - TORINO, Carlos Cognetti SGS, VIA TOLOMEO 1, 20019 - CASTELLETTO DI SETTIMO MILANESE: "Design Criteria of a Zm Diffused GaAs LED Optimized for Fiber Optic Communication at 34 M Bit/s"]

[Text]

Abstract. High radiance led's, emitting in the range 0.8–0.9 µm, are widely used in practical telecommunication systems. In spite of their relatively low efficiency, they are still very interesting, with good reliability characteristics and with a high yield manufacturing processes. In this work the design criteria of a Burrus-type, diffused led are presented, with the related experimental results. A device was obtained optimized for systems with a repetition rate up to 34 M bit/s over distances of 7–9 km, having an estimated MTTF of about [illegible] h at room temperature.

1. INTRODUCTION

In the last decade considerable progress has been made in optical fibres, optoelectronic devices and optical communication systems. Up to date, fibers reach attenuations of 0.2 dB/km at 1.55 µm and very low material dispersion ([illegible] ps/nm km [1,2]). Interesting values of attenuation minima exist at shorter wavelengths (2, 1.5, 0.7, 0.5 dB/km at 0.85, 0.9, 1.06, 1.2 µm) which may be used as suitable transmission channels.

Furthermore, led's and laser's are available, whose emitted light pattern [illegible] the wavelength of these minima; the materials used are GaAs and GaAlAs for transmission in the 0.8–0.9 µm range and InGaAsP to obtain sources up to 1.6 µm. The optical power actually coupled in a fiber for long distance links is about 50–100 µW for led's and some mW for laser's.

Finally, silicon PIN and APD photodetectors are used in the 0.8–0.9 µm range, while for longer wavelengths germanium PIN's and prototypes of ternary InGaAs and quaternary InGaAsSb and InGaAsP compound photodetectors are available.

In these cases, the experimental optical systems achieve very interesting goals concerning either repetition rate ([illegible] Gbit/s [3]) or transmission distance without repeaters ([illegible] km [4]). However, the current trend in commercial transmission systems is to operate at 0.8–0.9 µm ([illegible] window), using graded index fibers with attenuation [illegible] dB/km and bandwidths > [illegible] MHz km. Most of the applications are in telephone networks.

During the last two years laser sources have been tried frequently but under very conservative conditions: average distance of 2–5 km at about 10–20% of the maximum suitable optical power, the degradation rate being inversely proportional to emitted power. At present, work is in progress concerning laser lifetime and the improvement of the production yield, which is still very low. On the other hand, incoherent sources seem to be able to satisfy almost all settled system's requirements for applications in the average distance field up to 8–9 km (local exchanges in urban areas).

Their simple production process, high yield and long lifetime make this type of source still very attractive.

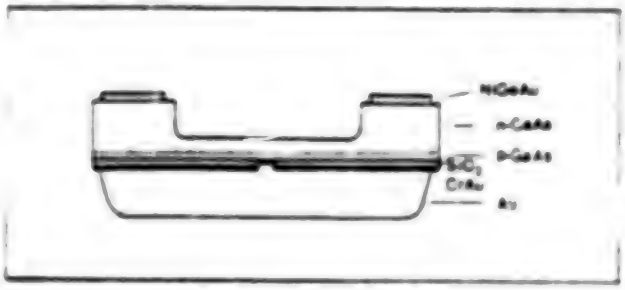

Fig. 1 - Structure of Burrus type led.

This work describes the optimization of a Zn diffused GaAs led (Burrus type - fig. 1) emitting at 0.9 µm, referring to its internal quantum efficiency, coupling to the fiber and technology.

2. DEVICE DESIGN

To optimize the diffused led it was studied how the Zn impurity diffusion profile is related to the external quantum efficiency, spectral line width of the emitted light and rise and fall times of the diode, taking into account that all these parameters are not independent.

It must be noted that the criteria we used are quite general, while results are a set of compromises depending on the specific application we worked on. The target was to obtain the best transmission distance at a repetition rate of 10 Mbit/s, with a fiber having a 62.5 µm core diameter, 0.27 numerical aperture (N.A.) and 3-5 dB/km attenuation.

2.1 General

To a first approximation the internal quantum efficiency of the led depends on the electron injection efficiency in the (p) side of the junction and on the quantum efficiency of the material of this region.

As second step of approximation, the profile of Zn dopant $C_{Zn}(x)$ is important and is also responsible for the minority carrier distribution $n(x)$ in the (p) region. The contribution of n-side is small, so we desgregard it hereafter.

In principle it is possible to write an expression for electroluminescence intensity $I(E)$ versus the energy E of the emitted photons and for the material quantum efficiency η:

$$(1) \quad I(E) = K \int_0^{x_j} R(x,E)\, e^{-\alpha x}\, dx$$

$$(2) \quad \eta_i = \frac{\tau_{tot}}{\tau_r}$$

In eq. (1) K is a constant depending on the material and on the relative refractive index n_r of the semiconductor and of the external medium (air, resin, antireflecting coating); x_j is the junction depth; $R(x,E)$ is the emission factor (radiative recombination rate, including $n(x)$); $e^{-\alpha x}$ is the exponential reabsorption term, depending on the absorption coefficient $\alpha(E)$. In eq. (2) τ_r and τ_{tot} are the radiative and total lifetimes of the electronic transition, depending on semiconductor doping level.
For step junctions (1) and (2) were calculated; the results agreed with published experimental values [5]. However, in the case of a diffused region, where C_{Zn} varies by several orders of magnitude from the surface to the junction, it is almost impossible to calculate exactly the external quantum efficiency due to two main difficulties:

1) $\alpha(E)$ is not an analytical function and different values of $\alpha(E)$ are reported for each C_{Zn} [6].

2) The dependance of τ_r and τ_{tot} on C_{Zn} [5, 6] is known with a noticeable degree of uncertainty.

However relations (1) and (2) are very useful for qualitative assessments.
To optimize the p-n junction a semi-empirical method was chosen, particularly it was verified how the surface concentration C_s and x_j work on the external parameter of the diode.

2.2 Emission intensity and wavelength, rise time

For a given dopant profile, C_s determines the minority carrier distribution $n(x)$, which in our case is not a simple exponential distribution as for a step junction (fig. 2). This causes $R(x,E)$, proportional to $n(x)$ [5], to have a maximum inside the p region.

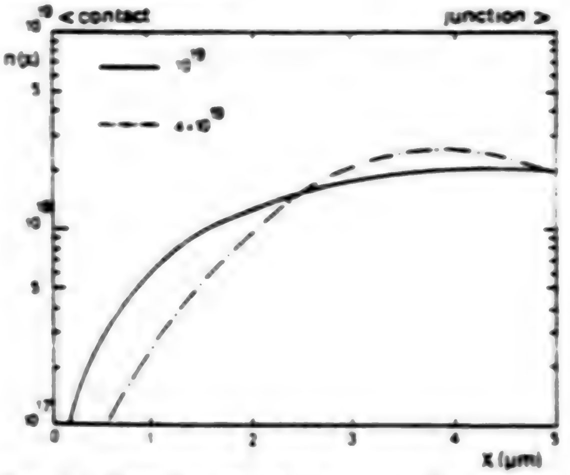

Fig. 2 - Minority carrier distribution in Zn diffused GaAs, for gaussian dopant profile. Diffusion depth is 5 µm; two values of C_s: 10^{19} cm^{-3} (full line) and 4×10^{19} cm^{-3} (dotted line) are considered.

The most attractive junction are those in which this maximum corresponds to the most efficient material.

By photoluminescence (P.L.) measurements, it was verified that GaAs:Zn has the highest quantum efficiency for $C_{Zn} \cong 10^{19}$ cm^{-3}; hence C_s was chosen in the range $1-4\times10^{19}$ cm^{-3}.

The total optical power of the diode depends on the value of C_s, assuming that x_j is larger than a few diffusion lengths of the minority carriers; in this case the non-radiative recombination at the contact must be considered.

At first approximation, C_s has to deal with the speed of the diode: in fig. 3 we show experimental data on the relation between optical power and 3 dB modulation bandwidth for different values of C_s. It may be observed that the optical power is at maximum around $C_s = 2.10^{19}$ cm^{-3}; for lower doping, efficiency is smaller and also the device speed decreases due to the longer carrier lifetime; for $C_s > 2.10^{19}$ cm^{-3} the led's bandwidth increases, as non-radiative recombination are more probable, due to micro-defects and, if $C_s > 5\times10^{19}$ cm^{-3}, to Auger recombination [8]. Diode rise time also depends on x_j: the lower the gradient dC_{Zn}/dx, the shorter is the penetration depth of the electrons, so that the recombination takes place in less doped material with longer lifetimes [7].

Moreover, C_s and the impurity profile determine the emission spectra for two reasons: emission comes from regions having different spectral characteristics and the emitted photons are absorbed by layers with different E_g .

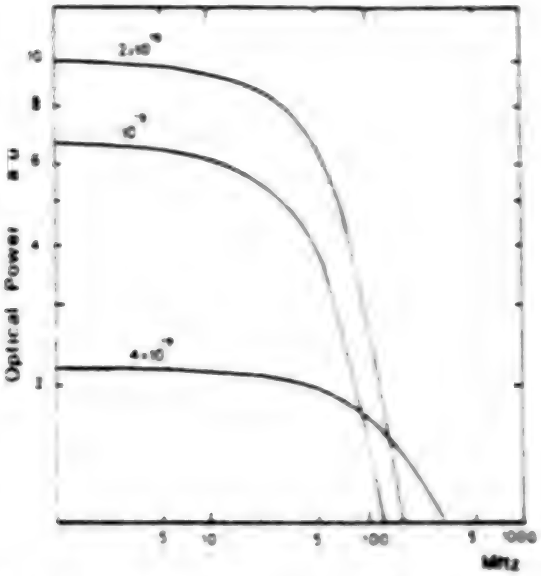

Fig. 3 - Modulation bandwidth for Zn diffused led's with x_j = cost and with different C_s (1, 2, 4 x 10^{19} cm^{-3}).

The maximum wavelength has negligible variations around 0.9 μm region, in which the fiber attenuation is practically a constant. On the other hand, Δλ is more critical and may increase from 25 to 40 nm with increasing C_s.

This parameter is very important for systems operating at 50 Mbit/s because the total time spread $\Delta\tau_c$ of an optical pulse after a travel L in the fiber is $\Delta\tau_c = \frac{d\tau_g}{d\lambda} \cdot \Delta\lambda \cdot L$; this relation clearly shows how the diffused led is superior to a multimode GaAlAs DH diode, which has typically Δλ = 40-50 nm.

2.3 Near field

From an electrical point of view the p region may be schematized as a series resistence and a shunt resistence (sheet resistence R_s). If the diffusion profile is known, the R_s may be calculated as the parallel sum of all layers dx, each with different resistivity $\rho(C_s, x)$ forming the diffused layer:

$$\frac{1}{R_s} = \int_0^{x_j} \frac{dx}{\rho(C_s, x)}$$

This parameter is responsible for the current spreading out of the electrical contact and hence of the width of the near field. In our case, typical values of R_s are between 15 and 30 Ω corresponding to a spread of 10-20 μm in the [illegible] field.

2.4 Coupling

The optimum near field beamwidth is related either to the core diameter of the fiber used for the pigtail or to the type of coupling chosen for the specific application under consideration.

There are two types of coupling: butt coupling to a flat fiber and coupling through an optical system. The more practical optical systems are: a truncated sphere of high-refractive-index material between the LED and the flat fiber (Fig. 4a) and a bulb ended fiber (Fig. 4b). This solution can be easily obtained by melting the end of the pigtail since the surface tension of the melted material naturally brings to spherical surfaces.

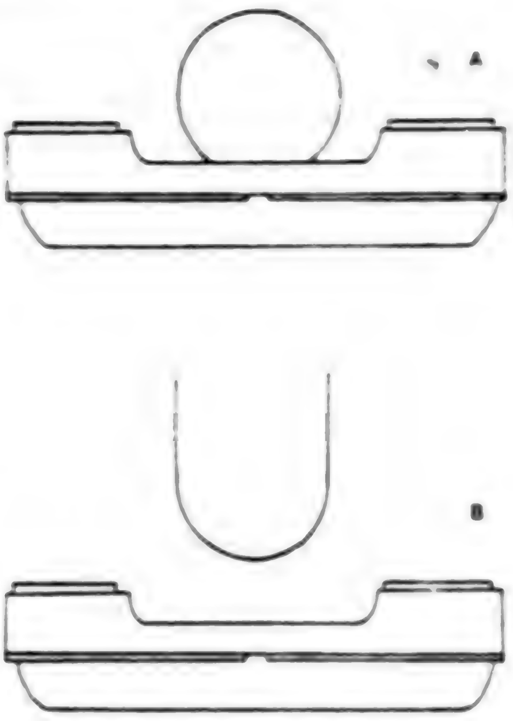

Fig. 4a), b) - Optical systems for the led-fiber coupling.
4a) Truncated sphere. 4b) Lensed pigtail.

The coupling to a flat fiber is certainly the simplest solution, the alignment of the fiber to the light source being that with the lowest tolerances. In this case the best solution is a near field width close to the diameter of the fibre core. With our led's, this type of coupling gave a mean optical power of about 30 μW in the fiber core.
For the second solution it is convenient to reduce as much as possible the source diameter in order to improve the coupling efficiency as stated by Liouville theorem [10] . However considerations on the reliability of the led may limit this approach. The value of current density must be less than 20-30 KA/cm^2, hence, for a fixed value of device operating current, the lowest contact diameter is determined. Therefore the minimum contact diameter which realizes the best tradeoff reasonable with the sheet resistance was chosen. From the above considerations we summarize in table 1 the values of the most important parameters regarding an optimized led coupled with a bulb ended fiber.

Table 1 - Most important parameters of a Zn diffused Led, optimized for optical fiber telecommunication systems ([illegible] M bit/s and λ=0.9μm

C_s	=	[illegible] - 1.5 × 10^{19} cm^{-3}
x_j	=	4 - 7 μm
R_s	=	15 - 20 Ω
$\emptyset_{well}$	=	30 - 35 μm

3. DEVICE FABRICATION

Led's were fabricated through a Zn diffusion on n (Si) ([illegible]-1.5×10^{18} cm^{-3}) substrates, (100) oriented, having a low dislocation content (Class A1, Sumitomo EPD < 500 cm^{-2}). The contact was photolithographically defined on plasma Si_3N_4 or CVD SiO_2 layers. After lapping to a thickness of 70 μm, both side of the slices were metallized with Cr-Au (p side) and Ni-GeAu (n side). The well was formed by a 5 H_2SO_4:H_2O_2:H_2O etching solution. An integral heat-sink pad (50 μm thick) was made by electrolitically grown gold. Dice were scribed and mounted with a soft solder on a stud-package (fig. 5). The wire was bonded by silver epoxy and by ball-bonding for comparison.

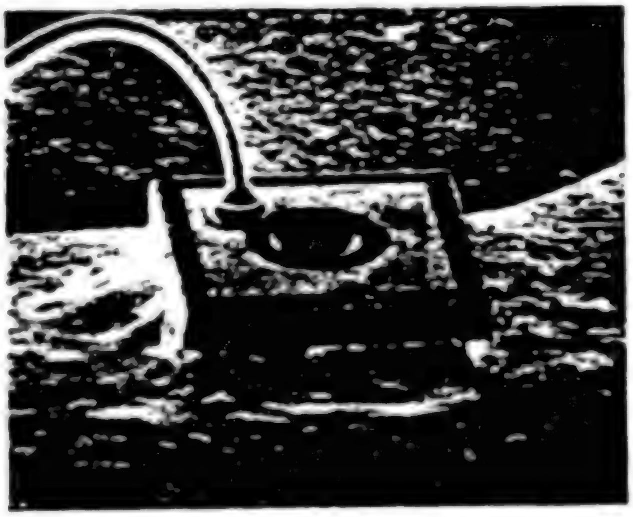

Fig. 5 - Led mounted on stud package with ball bonded wire.

3.1 Diffusion

As previously described, the junction must have precise characteristics: the diffusion is so the most critical step of the whole process.

It is performed in a sealed ampoule, evacuated at 10^{-6} torr, which contains the substrate and a convenient source of Zn [11].
During the thermal treatment an equilibrium arises among the phases of the system: source and substrate turn to the ternary compositions according to the phase diagram of GaAsZn. A suitable source belonging to the gallium-rich corner of the diagram makes it possible to avoid damage to the substrate due to the out diffusion of As, to obtain Zn surface concentration C_s = 1-1.5×10^{19} cm^{-3}, and limits the diffusion time to 30-90 min at T = 850°C.

As reported elsewhere [12], the relationship between the Zn atomic fraction X_{Zn} in the source and the surface concentration is in good agreement with published data concerning the solid composition at 900°C [13]; the slope of the experimental line is 0.5, as we are dealing with Zn concentrations lower than the solubility limit of this impurity in GaAs.

The diffused layer was characterized by photoluminescence measurements, four point probe, and SEM, with an accuracy better than 5%.

It was found that the diffusion conditions noticeably influence the impurity profile: it may be a supergaussian distribution with $C_{Zn} = C_S (1 - x/x_j)^2$, with a concentration depending diffusion coefficient $D \propto C_{Zn}$. Erfc profiles were found too, with C_{Zn}=C_S erfc (x) with D = cost. This kind of distribution was obtained by sources with the exact As content for diffusion times shorter than 60-80 min. This behaviour may be understood by admitting that the diffusion process is influenced by a non equilibrium of the Ga vacancies [13, 14].

Measurements of R_s confirmed the experimental P.L. profiles and agreed with the calculated values.

3.2 Reliability

The mean time to failure (MTTF) required to telecommunication devices is about 10^5-10^6 h at room temperature.

Since a direct measurement of such a long time is impractical, in practice accelerated lifetests are made at high temperatures T = 70-230°C. It is usually assumed that MTTF depends exponentially on the temperature as A exp (-E/kT). From the values of MTTF obtained at various temperatures it is therefore possible to evaluate the constant A and the activation energy of the degradation E.

Typical values of E are in the range 0.5-0.7eV for diffused led's.

During the life of the diode defects may appear in the active region: dark lines (DLD) oriented in (110) and (111) directions and dark spots (DSD) without a defined [illegible].

Device abnormally stressed during the production process (diffusion, polishing, die attach) show DLD's in the first hours of operation at room temperature. A burn-in procedure (300 mA, 24h) is sufficient to reveal led's of this kind (~10%) which are excluded from the reliability statistics. A preliminary test on 20 diodes, all selected after burn-in, was performed at 200°C and [illegible] kA/cm^2. The behaviour is similar to that reported by other authors [15].

The life of the device is characterized by at least three phases:

I phase) in the first 20-30 h emission drops to a value P which is the 70-80% of the initial P_0.

II phase/slow degradation.

III phase/fast degradation, down to a negligible
value of P/P_0.

The devices showed the behaviour of fig. 6, where two distinct families are present with different population, whose II phase is 100 h and > 750 h respectively.

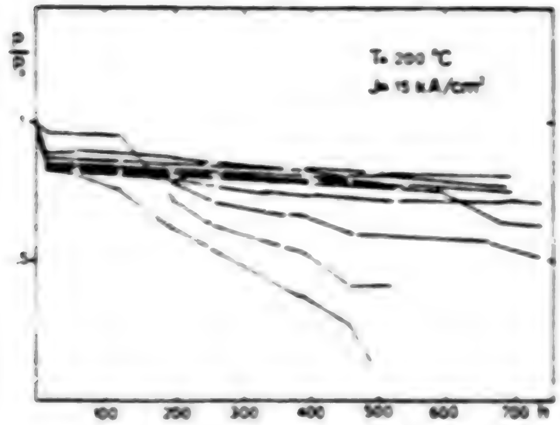

Fig. 6 - Degradation of the relative peak radiance at T_j=200°C and J_p=15 kA/cm².

Both families have diodes with DLD and DSD appearing during the test (30%): it seems confirmed that these macroscopic defects are not the main cause of the degradation [15]. Among the DLD's, some were observed arising from the periphery of the contact and growing along the (111) direction toward the center. The Si_3N_4 insulated devices showed these DLD's in a low amount. In this case better matching between the expansion coefficients of the semiconductor and the insulating layer may reduce the mechanical stress.

Thermal annealing alone does not cause any efficiency loss of the diode: degradation is activated by temperature in the presence of an electric field and radiation [16, 17].

It was assumed that the maximum operating current density is 30 kA/cm² (300 mA if $\emptyset_{cont}$ = 35 µm).

From fig. 6 a MTTF of 10^5 h for family A and 10^7 h for family B, may be extimated assuming E = 0.5-0.7 eV.

4. RESULTS

In fig. 7 two normal distributions of the optical power at 300 mA are reported for devices of the same diffusion run. The first is the distribution of the total optical power from the pigtail; the second refers to the optical power really available in the core of the transmitting fibre, calculated from the measurement of the residual optical power after more than 1 km of fibre (corrected by fibre attenuation).

Reported distributions show that 50% of device launch in the core more than 65 µW. The emission spectrum has λ_p=0.9 µm and $\Delta\lambda \leq$ 30 nm.

The risetime of these devices is ≈ 12 ns. Samples were obtained with risetimes of about 5 ns, whose radiance was lower of a factor 0.6-0.7.

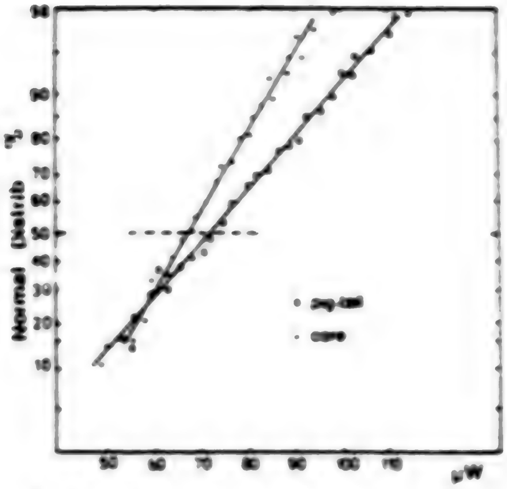

Fig. 7 - Normal distribution of the optical output from the pigtail (open circles) and from the core (dark squares) for a 62.5/125 graded index fiber, NA = 0.21.

Table 2 summarizes the data of the devices described in the present work.

Table 2 - Data sheet of LED's described in the present work.

	SGS/ATES-CSELT 954 F
P_0 Power output (µW)	65 typ (*)
drive current for P_0 (mA)	300
fiber core diameter (µm)	62.5
fiber N.A.	0.21
λ_{max} peak wavelength (nm)	900
$\Delta\lambda$ spectral bandwidth (nm)	30 typ
τ rise, fall time (ns)	10-12 typ (**)

(*) with cladding mode stripped.
(**) no pre-emphasis, no pedestal.

Field trials were performed in the experimental link Cos 3 / FOSTER [18] which is a 34 M bit/s system working on a 9 km space still with suitable system margin (tab. 3). This result covers the 100% of urban area links without regenerators [19].

Table 3 - COS 3 / FOSTER System data [20].

Span length (km)	9.150
Input power(*) (µW)	26
Received power (nW)	73
System margin (dB)	1.9
System dispersion (dB)	3.5
Total attenuation(**)	21.43
BER	10^{-9}

(*) NRZ Code, 160 mA mean drive current.
(**) including joint losses.

5. CONCLUSIONS

It is well known that present trend in the optical sources development for use in fiber optic communication systems is mainly aimed to long wavelength devices, both of LED and laser type, in order to take the full advantage from the fiber transmission properties in this wavelength range. However, performances of the simple high radiance diffused LED described in this paper, are more than adequate for a number of practical applications; for instance, with reference to the Italian telephonic network [19] nearly 100% of urban area links, up to 34 Mbit/s, may be covered without repeaters by this device (with an APD on the receiver side). The penalty due to the relatively high fiber attenuation at 0.9 µm wavelength is not a critical factor in this case since the link span is mainly set by chromatic dispersion. Therefore a careful attention has been paid to the linewidth reduction, which could be even improved by choosing appropriate thickness and doping of the n-type absorbing layer.

In conclusion we believe that intrinsic limitations of this device are well balanced by a number of attractive characteristics like low fabrication cost, very good reliability, simple operation and high temperature operation capability which could offer a remarkable advantage to the system designer, at least for systems currently at the stage of industrial development.

Acknowledgement

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LINEAR INTEGRATED CIRCUIT AUTOMATIC TESTING (LICAT) SYSTEM

Milan ALTA FREQUENZA in English Sep-Oct 81 pp 279-283

[Article by Vitaliano Tassinari, Vittorio Cereda TELETTRA S.P.A., VIA TRENTO 30, 20059 VIMERCATE: "LICAT System for Automatic Testing of Linear Integrated Circuits"]

[Text]

Abstract. In this contribution some considerations are reported concerning automatic testing of Linear Integrated Circuits and the LICAT System built in Telettra for this purpose is described in detail. Also the reasons for this choice are examined.

1. CONSIDERATIONS ABOUT AUTOMATIC SYSTEMS FOR CHARACTERIZATION AND SELECTION OF LINEAR INTEGRATED CIRCUITS.

It is well known that the continuous growth of the capacity of transmitting media has led to the research of greater and greater compactness of terminal equipments for telecommunication systems.

Miniaturization is achieved working in several fields, but essentially with the introduction of suitable technologies /1/ and with the aid of the integration of complete electronic functions.

Therefore Integrated Circuits are of fundamental importance.

These, in general, may be subdivided in two large categories: Digital Integrated Circuits and Linear Integrated Circuits. The first comprises entire logic families (TTL, CMOS, ECL, microprocessors, memories, etc....), the second includes, besides operational amplifiers and voltage regulators, other devices where at least there is an analogic information (at input or output) in one case; for example A/D and D/A converters, codecs for PCM multiplex, modulators, compandors, etc....

While the first of these (DIC) are mainly used in switching equipment, the second ones (LIC) are mainly used in transmission equipment, so some electrical characteristics (distortion, noise, frequency response) are immediately reflected on equipment performance.

In the instrumentation field there is a great branch dedicated to automatic testing, called ATE (Automatic Testing Equipment) and there are many companies specialized in their construction.

These systems are generally directed to a wide range of potential customers, then, they are equipped with a rather complex basic instrumentation, able to test "standard" characteristics according to catalogue sheets, and only by adding suitable options or "ad hoc" designed circuits they are able to satisfy their customers peculiar requests.

Even in basic configuration costs are very high, rising to some hundreds of thousand of dollars; if the system is specialized with several options, costs become even higher.

This is why these systems have been able to obtain such a great success only in the field of DIC automatic testing /2/, /3/, /4/.

As a matter of fact, the costs mentioned above are made more acceptable because of the high quantities involved and of the high number of "Standard testing" which are typical of the DICs.

Instead when concerning LICs ATE are not completely satisfactory because of the fact that the above conditions are not met.

Another selection method could consist in adopting a reference unit where the device must be inserted as part of the equipment and looking for overall electrical behaviour.

This method is easy to implement, but it is not completely satisfactory, because a great number of tests could be needed with excessive cost; furthermore, taking into account other components tolerances and that other devices on the same unit could be selected, it is very difficult to establish exactly the reference unit. A thorough knowledge of the device also would be affected and it could be difficult to find out if the devices which didn't pass selection could be used in other applications.

The choice made by Telettra, whose description is the content of this contribution, takes advantage at the same time of the benefits of both methods described above.

In effect it has been decided /5/ to make deterministic and not functional tests and to select the devices on the basis of an accurate technical specification, in order to have an assurance of good performance of the unit employing that device when the test is passed. Moreover "Standard" instruments, easily available on the market, driven by a computer through a IEEE-bus (according to IEEE-488 international standards) have been adopted; then to a specifically designed equipment the test circuits, the test frequencies, the required filtering and all "hardware" neeeded to choose through the computer program the test points and the test circuit configuration have been assigned.

As regards the first method described there is still the advantage of "General Purpose" instrumentation, but the amount of instruments needed is reduced to the bare essentials, while the specialized parts all placed in the added equipment.

The design of this equipment, even if complex, can be overcome fairly well by a telecom company; furthermore a specialized "Hardware" has the big advantage of simplifying the "Software" needed and of reducing test times. A simplified block diagram of the adopted solution is reported in figure 1.

In addition to the advantages already mentioned the following are listed :

a) simply, by changing the added equipment and leaving the rest of the system unchanged, one can pass to the selection of another device.

b) the computer and the instruments can be turned around very easily to other test systems.

c) more than one piece of added equipment can be built, making it possible to operate with several test heads.

d) the "software" is made easier by the specialized "hardware", so the test times are shorter.

e) being very flexible, system maintenance and repair is simplified.

f) the investment required is not too relevent. From a final calculation the cost is around 50% as regards to other equivalent systems available on the market (design cost included). If duplication are made the cost saving is even higher.

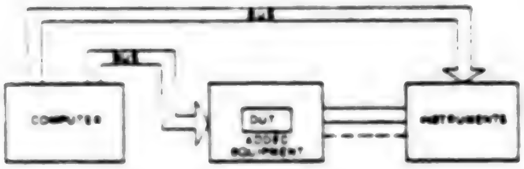

Fig. 1 - Block diagram of the system adopted by Telettra for automatic testing of linear integrated circuits.

2. LICAT SYSTEM DESCRIPTION

The system described earlier has been called LICAT (LIC Automatic Testing) and is presently being used at the incoming material department.

A more detailed block diagram is shown in Figure 2. The instruments are all from Hewlett Packard : 9825 A computer, 98032A and 98034A interfaces, 3455A DC and AC (true RMS) voltmeter and 7245A optional fast printer.

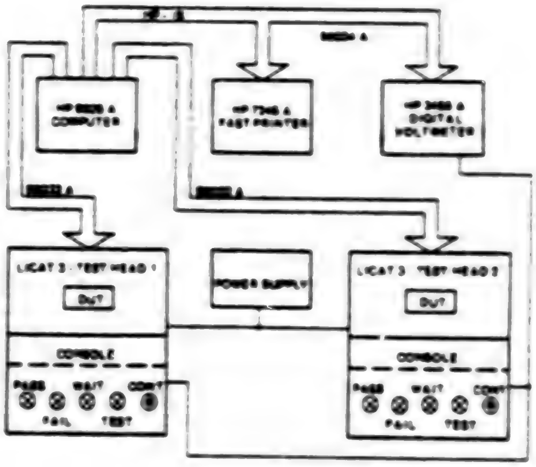

Fig.2 - "LICAT" system block diagram.

The system is equipped with two test heads and on each there is a "Console" with the CONT (continue) key and four light signals indicating "WAIT", "TEST", "PASS" and "FAIL".

Up to the present time seven added equipments have been built: four for op-amps, two for modulators and one for the expander LS150.

The selected op-amp are µA709, µA748 (2 types of selection) and the dual op-amps LS204 and RC4558 both selected with the same equipment LICAT4; the modulators are LS025 and MC1496.

In table 1 the electrical parameters which are measured the test conditions and test times are given for each device.

When the fast printer is not used, the test results may be available on the computer printer, or when selecting thousands pieces it is possible to print only the values outside the specification limits.

Furthermore, it is possible to store into the computer memory much data about the tests made; so statical investigations become quite easy and the most critical tests, or different lots, can be kept under control.

As an example in Figure 3 a simplified diagram of LICAT2 for µA748 or LS148 op-amps is shown.

In AC the open loop gain at 0.5 Mhz is measured, with a 4pF compensating capacitor between pins 1 and 8; this compensation differs from the one suggested by the catalog and is used with the purpose of lowering the output impedance, but may cause instabilities in presence of a load capacitor.

For this reason it has been necessary to filter the 0.5 MHz test signal through a band-stop filter and to check for the presence of unwanted signals.

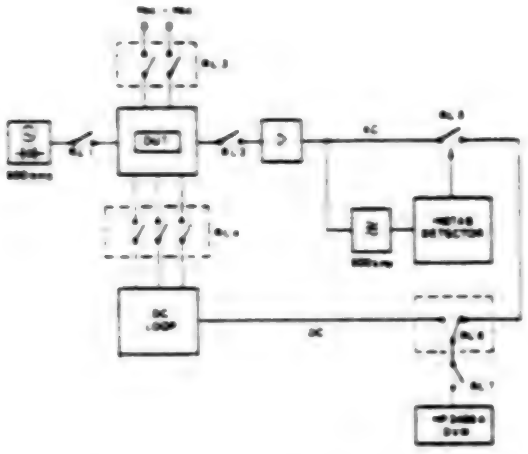

Fig.3 - "[illegible]" IC test circuit block diagram.

Through the "DC-loop", supply current (I-CC), input bias current (I-IB), input off-set current (I-IO), input off-set voltage (V-IO) and open loop voltage gain (AVOL) are measured. All tests are made with 12V power supply, rather than 30V as usually indicated in the catalogues.

In Figure 3 and 4, some of the relays driven by 98032A interface /5/ are schematically shown; the relays functions are indicated in the following :

RL1 and RL2 are closed for AC test.

RL3 disconnects the power supply to the DUT when the device must be inserted or removed from the socket.

RL4 inserts the "DC-loop".

RL5 opens when instabilities are present.
RL6 switches the 3455A voltmeter on the AC or DC test path.
RL7 opens when the voltmeter must be inserted on the second test head.
RL8 and RL9 signal if the device passes or fails the specifications.
RL10 is kept closed during test time.
RL11 closes as soon as the "CONT" key is pressed and opens when the test starts.
RL12 is kept openend during all test time.

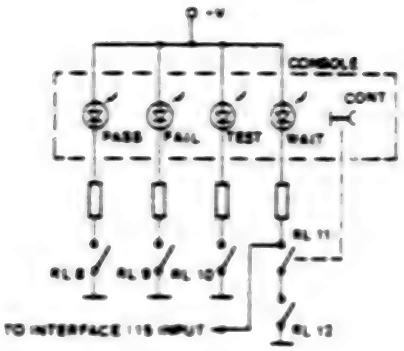

Fig.4 - Console schematic.

In figure 5), a schematic of the terminal part of the 98032A 16 bit interface, which transfers orders from the computer to the test head is also visible. All 16 binary inputs and output are used; these transform a decimal number, sent through the key-board or through a program statement, in 1s and 0s corresponding to the same binary decoded number. Each output must be connected to the corresponding input and to the relay coil.

For example, connecting the O2 output to the I2 input with the statement wtb 5,4; number 4 becomes 0...0100 and at the output O2 of the interface with code selection 5 there is a ground voltage which excites RL3. Moreover, the ground voltage is present also at the input I2, therefore holding the condition until another statement changes the setting.

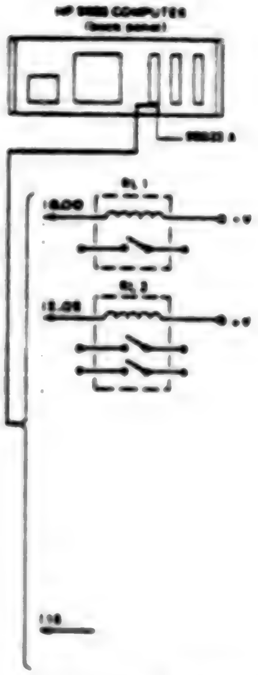

Fig.5 - Relay controls trough 98032A interface.

This operation is made before each test, as shown in the flow-chart of figure 5.

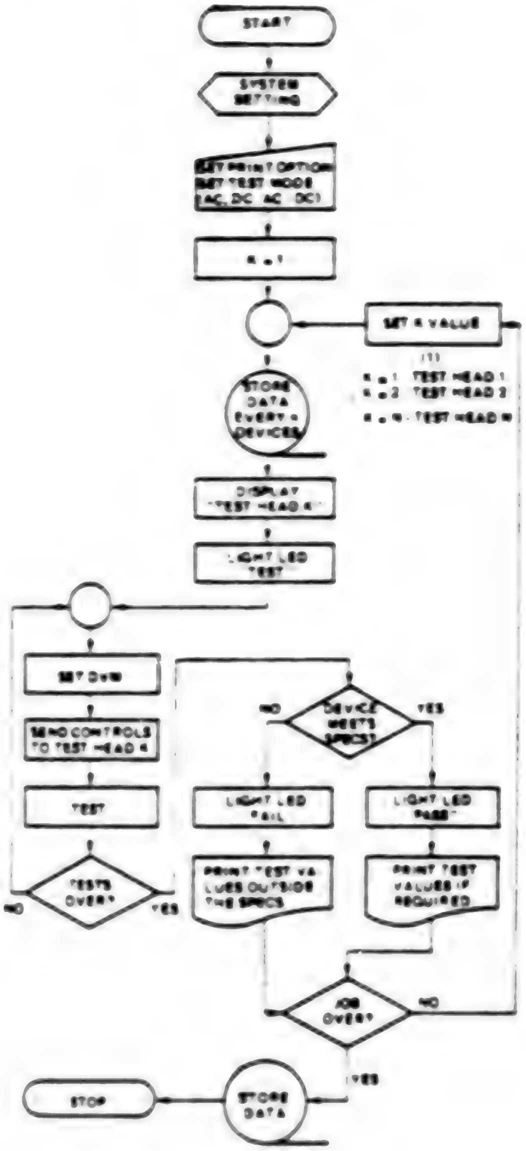

Fig.5 - "LICAT" system automatic testing flow-chart.

From this flow-chart and from the "Console" scheme of figure 4), it is possible to see that as soon as the "CONT" key is pressed the yellow LED "WAIT" goes on and a ground voltage is sent to the computer through the binary interface;this ground voltage is used to set K value (note (1)of figure 5).

The "WAIT" signal remains until the test on the other head is completed. Then, the yellow LED "TEST" goes on, tests are made on the test head in object, controls are made to verify the specifications and finally the green LED "PASS", or the red LED "FAIL" goes on.

At this point, the program goes on to the second test head if the "CONT" key had been pressed.

CONCLUSIONS

There have been aspects taken into consideration regarding Automatic Testing of Linear Integrated Circuits and then, reasons which have determined Telettra's choice of constructing the LICAT System.

Afterwards the LICAT System has been described in detail.

Since Automatic Testing Equipment available on the market is not completely satisfactory, a system of internal construction has been developed.

This has allowed our company to make low cost selections taking into account particular device applications on the basis of a precise technical specification.

Also the investment needed has resulted to be much less than in any other solution.

Acknowledgements

The authors gratefully acknowledge Dr. Ing. G. Stacchiotti and Quality and Reliability Department for helpfull discussions;also Dr. Ing. F. Colline and Mr. G. Oggioni for their partecipation in the "Hardware" design and in the equipment building are gratefully acknowledged.

Manuscript received on December 4, 1980

Tab. 1 - Summary for devices tested with "LICAT 1 ÷ 7" system.

DEVICE		TEST CONDITIONS	DC TEST	AC TEST	TEST TIME
LICAT 1	µA 709 LS 709	Supply voltage: 16 V Compensation: 10 pF @ pins 1 - 8, 3 pF @ pins 5 - 6 Signal input level: -70dBv	Supply current Input bias current Input offset current Input offset voltage Open loop voltage gain	Open loop voltage gain @0.8 MHz Instabilities detection	8.5 sec.
LICAT 2	µA 748 LS 148	Supply voltage: 12 V Compensation: 4 pF @ pins 1 and 6 Signal input level: -50 dBv		Open loop voltage gain @0.5 MHz Instabilities detection	6.5 sec.
LICAT 3	µA 748 LS 148	Supply voltage: 12 V Load resistance: 750 Ω Test signal: 3 kHz, 0 dBv input level		Max output swing @3 kHz Neg. supply Rejection Ratio @3 kHz Psophometric noise	9 sec.
LICAT 4	LS 204 MC 4558	Supply voltage: 12 V Load resistance: 600 Ω Test signal: 3 kHz, 0 dBv input level Both op-amps tested		Max output swing @3 kHz Neg. Supply Rejection Ratio @3 kHz Psophometric noise	18 sec.
LICAT 5	LS 025	Test circuit and test conditions are the same reported in SGS ATES Data Book Carrier signal (fc) 130 kHz, 15 dBv input level Modulating signal (fm) 25 kHz, 20 dBv input level	Supply current Carrier input bias current Signal input bias current Voltage @ pin 10 Differential voltage @ pins 9 - 10	Output resistance Output max. swing @fc - fm Output level of the following signals: fc - fm; fc; fm; 2 fm; 2 (fc - fm); fc + 2 fm; fc - 3 fm Low frequency noise High frequency noise	12 sec.
LICAT 6	MC 1496	Carrier signal (fc) 130 kHz, 9 dBv input level Modulating signal (fm) 25 kHz, 15 dBv input level Signal superimposed to supply volt. (-12 V) fd = 50 kHz, 15 dBv Bias resistance: 48.7 K and 18 K	Supply current Signal input bias current	(Balanced load 4.8 KΩ. Gain setting res. 600Ω) Output resistance Output level of the following signals: fc - fm; fc; fm; 2 (fc - fm); fc - fd Low frequency noise High frequency (near fc) noise	11 sec.
LICAT 7	LS 150	Test circuit and test conditions are the same reported in SGS ATES Data Book Unchanged input level: Ii = -14 dBv @ 800 Hz Input range: -40 to +10 dBv External time constant 20 ms	Supply current	Offset adjustment to null expansion error between Ii = -40 dBv and Ii = -14 dBv Expansion accuracy for entire input range Expandor and amplifier gain variations Output resistance Input dynamic biasing resistance Frequency distorsion Expandor and amplifier intermodulation, armonic distorsion Psophometric noise	25 sec.

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CSO: 5500/2031

BRIEFS

FIBER OPTIC CABLES INTRODUCED--In 1983 telephone companies in the country's three largest cities will begin large-scale use of fiber optics, i.e., light signals in glass cables, in their telecommunications networks. Malmo is working most intensively and is equipping five facilities for fiber-optic transmission between most of the city's telephone stations. This means that in several years most of Malmo's telephone customers will speak by way of glass cables. At the same time, Stockholm is equipping two facilities and Gothenburg one. Since the beginning of the year fiber-optic transmission of ordinary telephone calls between customers in parts of Vasterort has been tested. The results of this experiment have been so good that the technology is now considered ready to be used commercially. The advantage of the fiber optics system is that many times more signals can be conducted through a cable of given thickness if they are transmitted as light in glass rather than metal wires. This means that the great economic gains from this technology will come from the transmission of communications requiring large spaces in signal conductors, for example picture telephones, television, telefax, etc. The average customer will notice no difference, since in the foreseeable future ordinary electric wires will still lead to the home's telephone jack. The transition to and from light will occur at the telephone station. [Text] [Stockholm SVENSKA DAGBLADET in Swedish 1 Oct 81 p 8] 9336

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